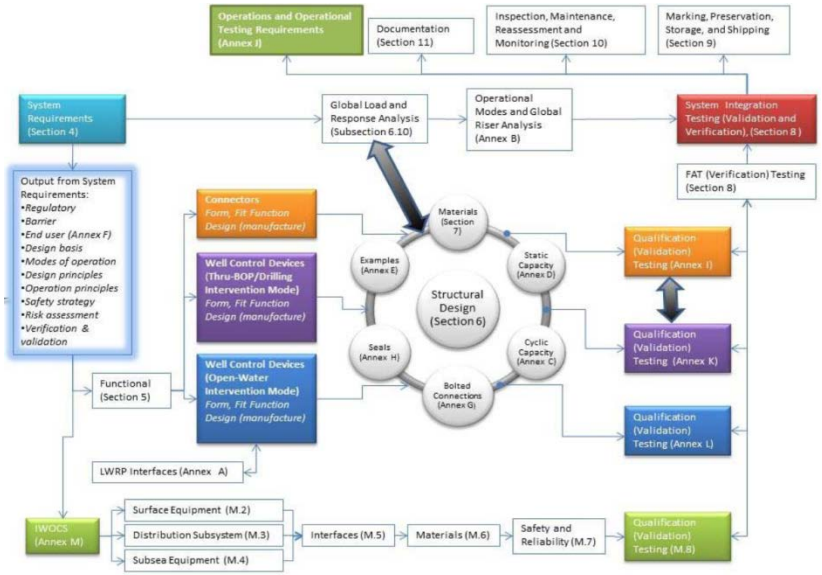
API Draft Spec 17G

Subsea Well Intervention Systems HPHT considerations



January 28th 2014
BSEE MEETING

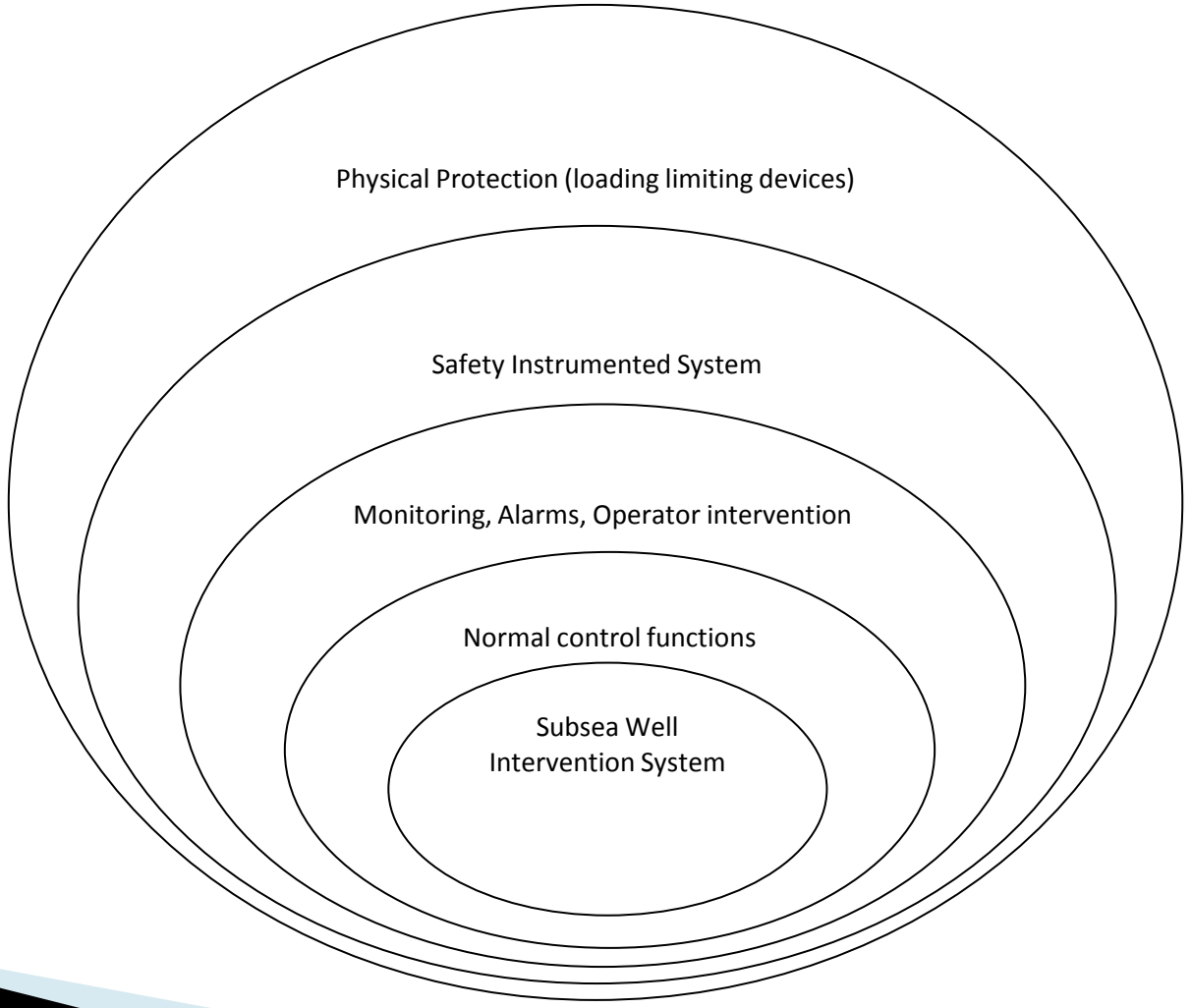
Introduction

- API RP 17G 1st edition: released 1995 for Completion/workover risers
- API RP 17G 2nd edition: 2006/ISO 13628-7 released 2005
  - Introduced the limit state design approach
  - Major updates on design requirements for pipe, connectors, material and connector qualification
  - Advanced riser design and connector qualification in the industry
- API 17G 3rd edition: (Ballot Draft) Excludes HPHT
  - Transition from RP to Spec. (Major Revision)- Advances design process for WCP, SSTT & forms the basis for emerging well intervention systems
  - Fully self contained, ensuring system and component life cycle integrity
  - Includes:
    - Well Control Package,
    - Landing String
    - Intervention Work Over Control System

API SPEC 17G ENHANCEMENTS

- **Safety Strategy**
  - Improved alignment between the End User and the Design / Performance of the Equipment and Operational Program
- **Material Integrity**
  - Chemistry
  - Prolongations
  - True Stress / Strain Curves to optimize for non Linear analysis Process
  - Charpy / Lateral Expansion
- **Design Process**
  - Static
  - Cyclic loads
    - Fatigue (SN or Fracture Mechanics methods)
- **Enhance Qualification** and Environmental Simulation process
  - Annex K, L, and I
  - Sand Slurry
  - Dynamic Closure Testing –
- **Testing Methods**
  - FAT/ EFAT & SIT
  - Crew drills

API Spec17G Safety Design Strategy



API SPEC 17G METALURGY & DESIGN

- Material properties, NDT, QC requirements compatible with the static and cyclic design methodologies
- Static design capacity methodology based on ASME VIII Div 2/Div 3, modified for offshore applications:
  - Strain limited approach to ensure:
    - Consistent structural design margins (Structural failure mode)
    - Component functionality (functional failure mode)
    - Assure NACE limits
- Look to TR8 for stress relaxation and operational aging of seals.

Comparison of codes

	API 17D	API SPEC 17G	ASME VIII 2	ASME VIII 3
Pressure limit	15K	15K	5K and above	10k and above
Analysis	Linear Elastic FEA	EP – 0.2% str/ Mod Limit Load	Elastic or EP + Str Hrd	EP + Str Hrd
Charpy V[1)]	20 J	40 J – 65 J	41 J (2 in)	41 J
Test specimens	QTC or Prolongation	Prolongation	Prolongation	Prolongation
Yield de-rating	180°C	50°C	40°C	40°C
Accidental load	No	Yes	Yes	Yes
Cyclic load	No/Yes[2]	Yes	Yes	Yes
Surface NDE acceptance	3/16" (5 mm)	"No detectable cracks (< 1/16")" @ fatigue hot spots	3/16" (5 mm)	1/16" (1,6 mm)

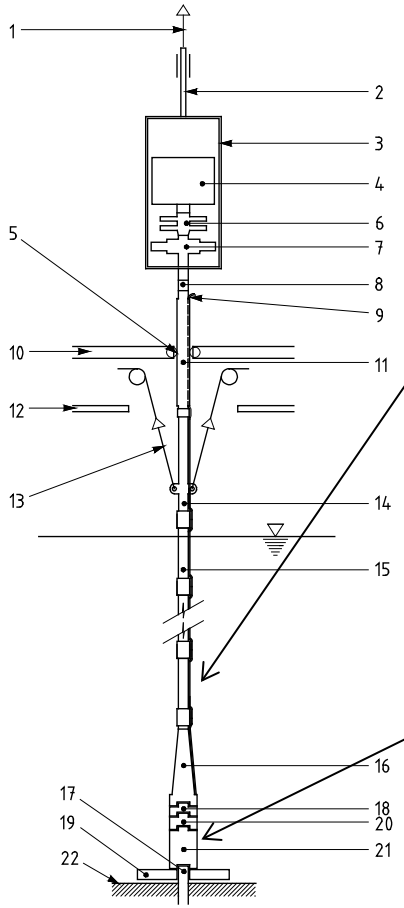
1) 75 ksi steel, 2 in thick

EP = Elastic-Plastic FEA

2) 17D mentions "fatigue considerations" but does not specify requirements and refers to 17G

Status: Draft

Code Split between API 17G and API 17D



API 17G

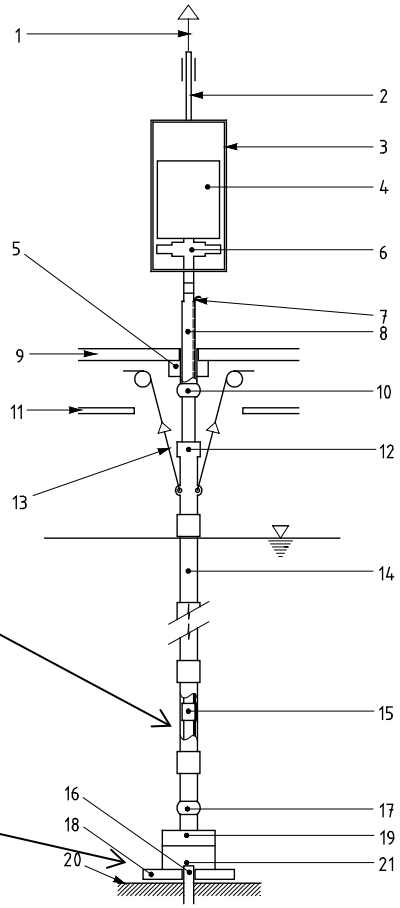
Open Water Intervention Riser System including WCP

Landing String and Subsea Test Tree Assembly

API 17D

XT

TH, THRT and Wellhead System



Open Water Intervention Mode

Thru-BOP/Drilling Riser Intervention Mode

Summary

- Design method consistent to dovetail with TR8:
  - The static design method gives consistent safety margin against failure
  - Provides consistent results for complex geometries and loads
  - The use of elastic-plastic method provides knowledge of strain in components
- Fatigue failure criteria dovetails with TR8 (below WCP, SSTT where primary barrier resides) so:
  - S-N curves applicable for environmental cyclic loads (>10,000 cycles per day) and pressure cycles (1,000 cycles for total life) for riser sections
  - Use of calibrated fatigue design factors for offshore applications (i.e. *high fatigue design factor to limit potential crack size*)
  - Inspectable components (i.e. temporary equipment)